

We claim:

1. A method for transmitting a signal from a plurality of antennas comprising:
encoding a stream of data according to a turbo multiple trellis coded modulation scheme
5 thereby generating a plurality of parallel channel-coded symbol streams;
space-time encoding the plurality of parallel channel-coded symbol streams, thereby
generating a plurality of space-time-channel-coded symbol streams; and
transmitting the plurality of space-time-channel-coded symbol streams from the plurality
of antennas.
10
2. The method of claim 1, wherein the space-time coding includes block space-time
coding.
3. The method of claim 1, wherein the space-time coding includes convolutional space-
15 time coding.
4. The method of claim 1, wherein the encoding the stream of data includes maximizing
a coding gain and the space-time encoding includes maximizing diversity gain.
- 20 5. The method of claim 1, wherein the signal complies with a communication protocol
selected from the group consisting of: orthogonal frequency division multiplexing (OFDM),
time division multiple access (TDMA), code division multiple access (CDMA), gaussian
minimum shift keying (GMSK), complementary code keying (CCK), quadrature phase shift
keying (QPSK), frequency shift keying (FSK), phase shift keying (PSK), and quadrature
25 amplitude modulation (QAM).

6. An apparatus for transmitting a signal from a plurality of antennas comprising:
an outer encoder configured to encode a stream of data according to a turbo multiple
trellis coded modulation scheme, thereby generating a plurality of channel-coded symbol
streams;

5 an inner encoder configured to receive the channel-coded symbol streams and provide
space-time coding to the channel-coded symbol streams, thereby generating a plurality of space-
time-channel-coded symbol streams; and

a plurality of antennas coupled to the inner encoder, wherein each of the plurality of
antennas is configured to transmit one of the plurality of space-time-channel-coded symbol
10 streams.

7. The apparatus of claim 6, wherein the outer encoder includes a plurality of parallel
coding chains, wherein each of the coding chains includes a trellis coded modulation encoder, a
block symbol interleaver and a QPSK mapper unit, wherein the plurality of coding chains
15 generates the plurality of channel-coded symbol streams.

8. The apparatus of claim 6, wherein the plurality of antennas are arranged so that a
fading correlation between the antennas is below 0.5.

20 9. The apparatus of claim 6, wherein the inner encoder is a block space-time encoder.

10. The apparatus of claim 6, wherein the inner encoder is a convolutional space-time
encoder.

25 11. The apparatus of claim 6, wherein the outer encoder is configured to maximize
coding gain and the inner encoder is configured to maximize diversity gain.

12. The apparatus of claim 6, including a symbol interleaver interposed between the
outer encoder and the inner encoder.

13. An apparatus for transmitting a signal from a plurality of antennas comprising:
channel encoding means for encoding a stream of data according to a turbo multiple
trellis coded modulation scheme, wherein the channel encoding means is configured to generate
a plurality of parallel channel-coded symbol streams;

5 space-time encoding means for space-time coding the plurality of parallel channel-coded
symbol streams, wherein the space-time encoding means is configured to generate a plurality of
space-time-channel-coded symbol streams; and

means for transmitting the plurality of space-time-channel-coded symbol streams from
the plurality of antennas.

10 14. The apparatus of claim 13, wherein the space-time encoding means includes means
for block space-time coding.

15 15. The apparatus of claim 13, wherein the space-time encoding means includes means
for convolutional space-time coding.

16. A method for communicating comprising:
encoding a stream of data according to a turbo multiple trellis coded modulation scheme
thereby generating a plurality of parallel channel-coded symbol streams;

20 space-time encoding the plurality of parallel channel-coded symbol streams, thereby
generating a plurality of space-time-channel-coded symbol streams;

transmitting the plurality of space-time-channel-coded symbol streams from the plurality
of antennas;

receiving the plurality of space-time-channel-coded symbol streams;

25 space-time decoding the plurality of received space-time-coded symbol streams, thereby
generating a received channel-coded symbol stream;

decoding the channel-coded symbol stream, thereby generating a received stream of data
that corresponds to the stream of data.

17. A transceiver comprising:

a transmitter portion including:

an outer encoder configured to encode a stream of data according to a turbo multiple trellis coded modulation scheme, thereby generating a plurality of channel-coded symbol streams;

an inner encoder configured to receive the channel-coded symbol streams and provide space-time coding to the channel-coded symbol streams, thereby generating a plurality of space-time-channel-coded symbol streams;

a plurality of antennas coupled to the inner encoder, wherein each of the plurality of antennas is configured to transmit one of the plurality of space-time-channel-coded symbol streams; and

a receiving portion housed with the transmitting portion, the receiving portion comprising:

at least one antenna for receiving a plurality of transmitted space-time-channel-coded symbol streams, thereby generating a plurality of received space-time-channel-coded symbol streams;

a space-time decoder coupled to the at least one antenna, wherein the space-time decoder is configured to decode the plurality of received space-time-channel-coded symbol streams, thereby generating at least one channel-coded symbol stream; and

a channel decoder configured to decode the at least one channel coded symbol stream, thereby generating a stream of received data.

18. An apparatus for transmitting a signal comprising:

- a QPSK mapper configured to receive input data;
- a first MTCM encoder and QPSK mapper unit coupled to the QPSK mapper;
- a first symbol selector and puncturer coupled to the first MTCM encoder and QPSK

5 mapper unit, wherein the first symbol selector and puncturer is configured to provide a first channel-coded symbol stream;

- a symbol interleaver coupled to the QPSK mapper;
- a second MTCM encoder and QPSK mapper unit coupled to the symbol interleaver;
- a symbol de-interweaver arrangement coupled to the second MTCM encoder and QPSK

10 mapper unit;

- a second symbol selector and puncturer coupled to the symbol de-interweaver arrangement, wherein the second symbol selector and puncturer is configured to provide a second channel-coded symbol stream;
- an inner encoder coupled first and second symbol selector and puncturers, wherein the

15 inner encoder is configured to receive the first and second channel-coded symbol streams and provide space-time coding to the first and second channel-coded symbol streams, thereby generating a first and a second space-time-channel-coded symbol streams; and

- a plurality of antennas coupled to the inner encoder, wherein two of the plurality of antennas are each configured to transmit one of the first and second space-time-channel-coded

20 symbol streams.